

COST AND MANAGEMENT

Vol. 32

PROFIT

**Standard Cost Accounting
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LOSS

***Official Journal of
The Society of Industrial and
Cost Accountants of Canada***

JANUARY, 1958

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- devising and giving effect to better management methods, and
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Cost and Management

VOL. XXXII

JANUARY

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STANDARD COST ACCOUNTING FOR CUSTOM BUILT PRODUCTS

By F. D. ROBINSON

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Mr. Robinson, who joined Diebold, Incorporated as assistant treasurer in 1951, has been treasurer of the company since 1954. Before joining Diebold, he had 13 years of supervisory accounting experience with Westinghouse Electric Corporation. A native of England, he holds a B.S. degree in accounting from Columbia University and is a member of the Akron, Ohio, chapter of the National Association of Accountants.

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J. J. Macdonnell is a partner in Price Waterhouse & Co., Montreal. He has been in charge of systems and methods work for his firm in Canada since 1945. He became a member of the Institute of Chartered Accountants of Quebec in 1937 and of the Ontario Institute in 1951, and is a former administrative industrial accountant.

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Allen Weiss is cost accounting supervisor of Lever Brothers Company, New York. Previously senior accountant, he joined the company in 1949. A C.P.A. in New York State, Mr. Weiss holds the degrees B.S. in mathematics (cum laude) from the College of the City of New York and M.B.A. in accounting from New York University's Graduate School of Business Administration. He is a member of the New York chapter of the National Association of Accountants.

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Mr. McBain is secretary-treasurer of Kellogg Company of Canada Ltd., London, Ontario, and has been with the company 30 years. A Registered Member and former president of the Society of Industrial and Cost Accountants of Ontario, Mr. McBain has also been active in the Council of the London chapter for many years.

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Editorial Comment . . .

"COSTS AND PROFITS"

The story of the shrinking profit margin is told in the December 1957 *Newsletter* of the Canadian Chamber of Commerce. It is a story worth retelling.

A profits table compiled from information published by the Department of National Revenue appears in that issue. Based on returns filed by Canadian companies from 1944 to 1955 inclusive, it shows that, depending on the year, one fifth to one third of the reporting companies operated at a loss. Those operating at a profit earned, after taxes, between 2.7% (in 1954) and 5.1% (in 1950) of the sales dollar. The return on sales in 1955, the last year for which figures are available, was 3.3%. 1956 may show the same or even a better return, but one does not have to be a prophet to foretell that 1957 will show a further shrinkage in the return on sales margin without much hope that the tide may turn in 1958.

The *Newsletter* tries to make it clear that business could and should not be blamed for taking too large a share of the price of the product as a profit.

Commenting on the *Newsletter* in the *Globe and Mail*, Fraser Robertson bemoans the fate of the investor in shares who is supposed to be satisfied with a return less than that on Government of Canada Bonds; Robertson even links the problem of mounting selective ownership of Canadian resources by foreign investors with the shrinking returns.

If labour costs keep on rising without a corresponding increase in productivity, a likely prospect considering the annual automatic increases in wages and the inevitable increase in unit costs caused by a decrease in production volume, the final result is inevitable: a further decrease in the purchasing power of the dollar. Until the 1957 fall in our stock markets, the extent of which is not fully realized by non-investors (some "blue chips" stocks fell as much as 40% and more from their top quotation), the investor in equities could be content with a relatively modest return on his investment since he hoped that his shares would increase in price commensurate with or even exceeding the loss of purchasing power of the dollar, whereas bonds would not compensate for this loss. Many investors are sadly disappointed in this respect and will not pay too much attention to this argument for equity investment in the near future at least.

EDITORIAL COMMENT

The profit margin on sales is not necessarily indicative of the return on investment nor of the return on the market value of shares. The latter may have even improved on account of the sharp decline on the stock market in 1957 which again may have occurred in anticipation of declining dividends, a vicious circle.

If dividends could be maintained at the 1957 level, the lower stock prices would, of course, automatically increase the percentage of return on investment in stocks, but the shrinking profit margin on the sales dollar, combined with barely maintained and perhaps reduced volume of sales, must lead to a decrease in net earnings and thereby dividends, whereas bond prices still hold out the hope of a price increase coupled with a good interest rate.

The cost/price squeeze has its distinct limitations; the producer can absorb cost increases only to a point where he fails to make a profit at all. It would be unwise to wait for this moment!

For the industrial accountant, the data on shrinking profit margins are of particular interest because many management decisions in this area will be based on information which he will have to provide. This information must be based on sound premises which should be stated clearly. The adequate presentation of the effect and results of the change in purchasing power of the dollar is still a challenge to the whole accounting profession. The value of fixed assets may be understated in many cases in the investment figures shown.

Management will have to mobilize all their resources to cope with this dangerous situation by increasing productivity, i.e., output at maintained or even decreased total costs, a difficult task with one factor, labour, beyond the individual management's control. Sober planning—in the industrial accountant's sphere, realistic budgeting—will be needed more than ever. Sound and efficient use of labour, plant and capital will be imperative. The accountant whose tools are up to date, who masters the technique of "Return on Capital Employed" and of proper productivity accounting, who knows how to figure marginal costs, is familiar with the direct costing approach and preserves his flexibility in changing conditions, will be indispensable in the management team in the years to come.

Finally, it is the industrial accountant's duty to provide the necessary data for a better public relations job than business has been able to do so far in presenting the true story of the modesty of the average profits made and the indispensability of reasonable returns for the risk capital invested in business and industry!

SOCIETY STAFF APPOINTMENTS



D. A. GILLIS, B.Com.



W. R. KIRK, M.A.

M. C. Coutts, President of the Society of Industrial and Cost Accountants of Canada, is pleased to announce the appointment of two new members to the administrative staff of the Society: W. R. Kirk as Administrator, Educational Services, and D. A. Gillis as Administrator, Conferences and Seminars.

The appointments are in line with the complete organizational rebuilding the Society has undertaken in the past year to keep pace with the rapid growth of its membership. In their newly created positions, Mr. Kirk and Mr. Gillis will be able to extend and develop the services offered by the Society and make possible more effective forward planning.

For the past five years Mr. Kirk has been Assistant Director of Extension, University of Toronto, in charge of the business and industry courses which include the R.I.A. program. His administrative experience and familiarity with the R.I.A. courses admirably suit him for his present post. He holds a master's degree from the University of Toronto.

Mr. Gillis was formerly Assistant Manager, Ontario Division of the Canadian Manufacturers Association. He graduated from St. Francis Xavier University with a B.Com. degree and is working towards his master's degree in business at the University of Toronto.

A. S. Barley, B.A., will continue as Administrator, Membership Activities, a post he has held for the past 18 months. He will direct Chapter and Membership Relations with the 29 chapters and 6,500 members. C. C. Potter, B.Ss.Com., M.Com., Ph.D., C.A., continues as Administrator, Research.

C. & M. Round-Up . . .

LOOKING AHEAD

New Fuels are being sought in laboratories all over the world. These are necessary to propel supersonic aircraft, rockets and space ships. Exotic chemical combinations will produce speeds of thousands of miles an hour. Tremendous heat producing qualities are necessary. Hydrogen and barium are excellent starting bases having 52,000 and 25,000 B.T.O.'s per lb. respectively compared to hydrocarbin at 19,000 B.T.O.'s per lb.

—o—o—

The Recession will be with us another six months and a creeping inflation for another decade. So says a Princeton University economics professor. Probably as good a guess as any!

—o—o—

Appliances will be rented in the future by appliance makers rather than sold. This will enable automated factories to predict production schedules. A view by a professional economist (Peter Drusher).

—o—o—

Fast growing pulp tree has been developed by biochemists in the U.S. The new tree flowers in two years instead of ten.

—o—o—

World travel in less than six hours is here. Jet airlines will soon be covering the oceans and continents as well as local air travel. Due to competition, cheaper fares are in sight. One bottleneck will be hotel accommodations in the now unfrequented spots of the globe. The U.S. is still the No. 1 travel spot for Canadians with Europe the leader in overseas destination.

—o—o—

ON THE PERSONAL SIDE

General merchandise supermarkets are on the way. Before the end of this year three such establishments will open in the Toronto area. They will handle food, clothing, appliances, furniture, cameras, books etc. Non-food items will outnumber food two to one. Discount house prices will prevail and in some cases time payments plans will operate. The one-stop shopping principle is about to start in Canada.

Air conditioning can be rented, if you drive south this winter. About \$35.00 per month will bring a two wheel trailer with all necessary equipment to connect to your car.

Pay-as-you-go TV will be tried this year in major Canadian cities. It is now in production in the U.S. and will be promoted in Canada.

Teenage Girls have the researchers baffled. A recent survey shows 94% wanted to marry but only 3% want to be housewives.

Outlook for professionals is still good, according to N.C.S. Demand for engineers has declined but is still good. Commerce and accounting is in good demand.

COST AND MANAGEMENT

OF GENERAL INTEREST

This year should see a new round of wage increases after a relatively quiet 1957. A lot of two-year contracts are over this spring, particularly in the automotive field.

Unemployment will continue at a higher level this winter than any time since pre-war days but cannot be said to be really serious.

The C.M.A. believes that equal legal responsibilities are necessary between management and labour. Major points are that unions be subject to prosecution in event of unlawful strikes, prohibition of unlawful picketing and mandatory disclosure of union financial and administrative business.

Labour management arrangements covering health insurance benefits are bound to be hard to straighten out once the new National Health Scheme is in force.



NATIONAL HEALTH INSURANCE

What will happen in Ontario when the provincial hospitalization plan goes into effect January 1959 will no doubt set a pattern for other schemes of similar scope. Here are a few pertinent points:

Private insurers must cancel or amend all hospital contracts and vacate the standard ward field.

The care is available to all . . . compulsory to all employees of firms with fifteen employees or more.

Employer-employee arrangements for hospital care will have to be negotiated afresh since a great many variations of part and full payment schemes exist.

Premiums income to insurance companies will be sharply reduced until sales promotion of supplementary benefits gets underway.

In addition to accommodation and meals at standard ward level, the coverage will include nursing (excepting private duty), lab. and radiological service, drugs, etc. as approved, use of operating rooms, routine surgical supplies, use of radiotherapy for cancer and physiotherapy where available.

There is no limitation for stay, age, occupation or pre-existing conditions.



THE ECONOMIC OUTLOOK 1958

The experts say:

We are at a plateau. There is a pause, we are having a breathing spell, or more bleakly, a recession.

Duration . . . six to nine months.

Unemployment may reach 500,000 this winter.

Consumer prices will depend on wage settlements.

Consumer goods will go on growing due to population increases and large immigration in 1957.

Defence spending in the U.S. may affect our export picture. Russian satellite scare will most likely send such spending to higher than ever levels.

Capital expansion will slow down, or at least the backlog will be sharply reduced as compared to 1956.

Standard Cost Accounting For Custom Built Products . . .

By F. D. ROBINSON,
*Treasurer,
Diebold, Incorporated,
Canton, Ohio.*

In this article the author describes how a standard cost accounting system was successfully substituted for a job order cost system in the manufacture of custom built products. At no increase in clerical costs, the new system ensures prompt and accurate cost information, at the same time eliminating troublesome control and accounting problems.

IT IS my purpose in this paper to describe the way our company has successfully applied a 100 per cent standard cost system to the manufacture of custom built products.

As a background to this discussion, a brief description of our company will probably be helpful. We operate three manufacturing plants, one large warehouse, and 52 direct sales and service outlets. We employ 2,200 people.

We manufacture a complete line of bank vault equipment, including vault doors, vault linings, safety deposit boxes, burglar alarms, and interior partitioning. Most of this equipment is made to the dimensions and specifications of an ordering bank's particular requirement. The safety deposit boxes are a good example of custom manufacture: The locks must each be keyed to avoid duplication and complete, accurate records kept so that subsequent add-ons do not duplicate existing key patterns. Each compartment is, of course, individually numbered. The sizes of the compartments vary from bank to bank, being determined by the requirements of customers expected to lease the safety deposit facilities.

Our business systems and protection products line consists of safes, chests, vertical and rotary filing equipment, business forms of both stock and special order type, and the most complete line of microfilm equipment in the industry, including cameras, readers and film processors.

The previously mentioned protection products divisions are backed up by a nationwide service organization, which maintains our equipment under annual service contracts and handles over-the-telephone requests for service.

Our hollow metal products division manufactures steel doors and frames for homes, apartments and commercial buildings. Originally, the basic idea behind the steel door and frame business was to effect savings to the consumer by standardizing dimensions and thus make possible mass production. Unfortunately for the trade, these steel door dimensions are not standardized. Each architect seems to want doors built to his own specifications at a price comparable to that of an installed wooden door. And so, we and the others in this industry are furnishing top quality custom made steel doors and frames at less than \$20.00 per set.

COST AND MANAGEMENT

Control and Accounting Problems

With such a broad product line, I think that you can appreciate the imperative need that we have for prompt and accurate cost information. The management and control problem is acute because it is literally true that no one day's work in our shops will duplicate that of another. Therefore, simple rule of thumb guides to direct labour efficiency based upon end-product output and related to past experience are not practicable.

By 1952, we had concluded that our after-the-fact job order cost accounting was inadequate to meet the needs of our business. At that time, we were crediting inventories at an estimated value per unit for the products shipped to customers and adjusting cost of sales in a later period for the difference between the total actual accumulated job order costs and that relieved from the inventories at the estimated values. Such differences were practically always additional charges to cost of sales, and would run as high as \$40,000 per month. In addition to these losses on completed orders, we found at physical inventory time, additional losses from our book value together with sizable adjustments between the various inventory account classifications of raw materials, purchased parts, manufactured parts, work in process, and finished goods. Ironically, our salesmen were selling business systems equipment for modern inventory control procedures every day while we at the home office were living with an antiquated system.

We decided that the key to the solution of both the control problem and the accounting problem was to expand our work measurements on direct labour from about 50% of the productive operations to 100% and to charge inventories for only the value of the standard work measurement. All variances from these standards were to be developed weekly by the departments responsible. Our thinking was that products don't develop cost variances—but men do. And our job is to manage men, using fair standards to gauge their performance.

Our first action was to design a form of process sheet (Exhibit I) as a combined job routing sheet, an operator instruction ticket, payroll ticket, production dispatch record, material requisition, material identification ticket, and the basic cost department record. We run this standard multilith master over different run-off cards depending on whether we wish a labour ticket, a material requisition, or a cost work sheet, etc. When we run off labour tickets (Exhibit II), we provide one ticket for each operation and circle the number of the operation which has been assigned to each specific ticket. Thus, while the ticket is valid for only one operation, it shows the operations preceding and/or following.

We added four timestudy men to increase our work measurements from 50% of direct labour hours to 100% of such hours. As a matter of interest, we were able to save this extra payroll cost by reducing our tabulating machine rentals by \$15,000 a year as we eliminated the need

Multipurpose Process Sheet (Multilith Master) EXHIBIT IINDUSTRIAL ENGINEERING
OPERATION WORK COPY

SHOP ORDER NO				PLANNED DATE		QUANTITY THIS ORDER		SHEET		PART NUMBER	
COST COPY REQD		TO FINISH		TO START							
YES		NO									
SHEAR BILL NO				STOCK PARTS LIST NO				CUSTOMER			
SPECIAL REMARKS				PREPARED BY - DATE				ROUTED FOR QUAN OF			
PART NAME - PER PRINT				SIMILAR TO PARTS				PRODUCT CODE			
Receptacle Closure								104			
MATERIAL SPEC. AND SIZE (FOR PART ONLY, PER PRINT)				WEIGHT				FINISH SIZE			
See B/M 01-46706				BZ				12-10-54 bm			
ISSUED BY				APPROVED BY				DATE TYPED			
DESCRIPTION OF OPERATION				STD SET UP HRS				LAB RATE			
SHOW N.J. OF MEN REQD PER OPERATION MORE THAN ONE				PER PIECE				TOTAL			
DEPT NO				TOOL NO				DEPT NO			
MACH NO				OPER NO				TOTAL BURDEN			
10 CD				10 Assembly				.1			
				(1) 01-46707 Body				.29			
				(1) 01-46708 Locking Plate							
				(1) 01-46709 Lock							
				(1) 01-25961-15 Flat hd. Mach. Scr.							
				(1) 01-29660-06 Soc. Hd. Set Scr.							
				(1) 01-26854-00 Soc. Hd. Set Scr.							
17				20 Spray Lacquer				.04			
54				30 Inspect							
STOCK PARTS-SHOP ORDER				DATE				UNIT COST - LABOR			
COST DEPT. PERMANENT COPY				1-1-55				.33			
1412				UNIT COST - MATL				4.60			
				UNIT COST - BURDEN				4.93			
				UNIT COST - TOTAL							

Labour Ticket

EXHIBIT II

STANDARD COST ACCOUNTING FOR CUSTOM BUILT PRODUCTS

to price out labour tickets, material requisitions, and tabulate job order costs. Obviously, many of these new time-standards were set from so-called "standard data" and not from actual stop-watch observations.

The cost department takes its run-off copies of this order set and extends the standard allowed time for each operation by the combined labour and overhead rate applicable to the department in which the work is to be performed. Set-up costs are spread over the standard ordering quantity. These individual extensions for labour operations are summarized to get the total standard labour and overhead cost of each part. The material requirement is also shown on this labour ticket, and it is priced at standard material costs and added to the total labour and overhead cost to arrive at the total standard cost of the part. As I show later our cost department no longer receives any direct labour tickets or material requisitions except for the exceptions charged to capital account or overhead.

The same general procedure is followed for the labour tickets used to make assemblies and end-products. The only difference is that the material portion of the total cost is obtained by pricing out the applicable bill of material (Exhibit III). In this way, our cost department determines the standard value for each of our parts, assemblies, and products whether standard or custom-built. Its problem is to enforce these standards by: (1) seeing to it that all variances from these standards are charged directly to cost of goods sold by the departments responsible, and (2) relieving the inventories at these standard costs.

A not inconsequential value of the above-described system is that where, under job order accounting the factory supervision used to be able to question the accuracy of the timekeeping and the cost accumulations, in the new system we simply point out to them that we have merely priced out their own process sheets and bills of material. Thus, the time formerly spent arguing about the accuracy of the costs can now be applied to studies of the basic labour operations or material requirements that are causing high costs.

Earlier, I stated that the cost department did not receive any direct labour tickets or material requisitions except for the exceptions chargeable to capital account or to overhead. I would like to outline how we accomplish this.

Each labour ticket is reproduced from a multilith master that contains, as fixed information, the standard allowed hours per unit. On the floor of the shop, the labour ticket is time-stamped "in" and "out" on an electric job time recorder. In addition, the quantity of pieces completed for the specific operation involved is written on the labour ticket. With this information, the payroll department computes the standard allowed time for the pieces produced and, in addition, the applicable elapsed time as shown by the clock rings. The individual labour tickets are sorted by departments, and totals are obtained for each department showing the total departmental standard hours, total

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STANDARD COST ACCOUNTING FOR CUSTOM BUILT PRODUCTS

actual hours, total gain hours, and total loss hours. These figures are presented to management in a weekly labour efficiency report.

The total standard direct labour hours developed for each week are accumulated by the departments on a worksheet and at the end of the month we multiply the month's total standard productive labour hours by the various departmental standard direct labour rates. The total of these extensions (which is only 20 as we have 20 productive departments) is charged to work in process as the month's direct labour input. These same standard hours for the month are extended by the overhead rates applicable to the 20 departments and summarized to give the monthly charge to work in process for burden absorbed. The cost department receives no detail for labour overhead other than these summaries of standard labour hours. There is no detail supporting work in process.

At the time each order is released to the shop for manufacture, cost copies are furnished to the accounting department for all new masters reproduced for the first time. These new masters are either for changes in the manufacture of old products or are required for a new product or a special order. As we have seen, this cost copy is an exact duplicate of the labour tickets released to the shop. The cost department can thus extend these new masters and compute the standard cost of a special product before manufacture even starts.

This technique of furnishing the cost department with copies reproduced for the first time only, is, of course, based upon the principle of control by exception. It is assumed that the cost department has already received and costed all items for which a prior copy of these process sheets has been run and will use these old costs to cost the new order.

The method we have used to avoid the necessity of forwarding material requisitions to the cost department is, I think, of interest. It was this freedom from the chore of pricing, extending, and footing individual material requisitions that afforded us much of our savings under the new system.

Our raw material, purchased parts, and manufactured parts inventories are controlled by perpetual records maintained by the production department. These perpetual records consist of individual ledger cards for each item of these inventories, and are machine posted for receipts and issues as well as for orders placed and for material reservations.

As we decide to build end-products for either stock or for special order, we reproduce our multilith bills of material for these products. If it is a "first time" reproduction, the cost department will receive a copy, just as was the case with "first run" copies of the labour process sheets. The production department will review the "on hand" and "on order" status of the parts and raw materials called for on these bills of material and reserve the quantities of parts and materials required to

COST AND MANAGEMENT

build the assembly schedules. If sufficient parts and raw materials are not on hand to meet these assembly schedules, purchase and/or shop orders are placed to obtain them, and the order numbers so assigned are written on the bill of material adjacent to the part numbers so ordered. This marked up copy of the bill of material is then sent to the storeroom and used to issue the parts and materials to the shop for fabrication and assembly.

When the materials and parts have been withdrawn from stores, the marked up bill of material is stamped "issued" and the bill of material is returned to the material control clerks in the production department, who then post the perpetual records to record the issues.

At month's end, we carry the ledger trays containing the perpetual records to the tabulating section where key-punch operators transfer the final balance in stores to a pre-punched deck of tabulating cards. This deck of tabulating cards was reproduced mechanically from a master deck containing part number, unit standard cost, product used on, and ledger tray number. One important by-product of this system is that we insure getting a ledger card for every item in stores. We then mechanically extend each tabulating card and tabulate the total value of our raw materials, purchased parts, and manufactured parts.

These three total figures are then given to the cost department, where the final balance is set up as our general ledger value for raw material, purchased parts, and manufactured parts. The difference between these month-end figures, and whatever balance was on the general ledgers before this entry, is transferred to work in process as the month's issues from stores to work in process.

Because we physically inventory our raw materials, purchased parts, and manufactured parts throughout the year on a cycle basis, and our actual counts are within 3% of the perpetual records before adjustment, we know that our general ledger values for these inventories at month-end are accurate within 3%.

One of our guiding principles is that inventory adjustments based upon errors in cost, while painful, are really "baloney dollars", whereas the clerical hire expended to avoid such adjustments are real dollars. We strive to keep our cost of goods sold figures accurate within 1%, and we provide a reserve for cost errors of 1% of the amount relieved from inventory each month.

Previously, I described how we used the bills of material to relieve the perpetual inventory records. We have a couple of short cuts that I think will be of interest.

We do not use this system for steel sheet and plate. We make no records of reservations or issues of such steel. Each month-end, we physically inventory such steel and set these quantities up as the month-end balance on our perpetual records. We maintain a 45 to 60 days supply of steel from past historical experience.

STANDARD COST ACCOUNTING FOR CUSTOM BUILT PRODUCTS

We do not maintain any records of receipts and issues on hardware such as nuts, bolts, washers, and rivets. Instead, we have set up a fixed value for such hardware on our ledgers and we charge receipts directly to work in process. We box the quantity estimated to be the usage for the time required to obtain replenishing stocks of such hardware, and request the storekeepers to re-order the standard ordering quantity whenever they get down to the point where only the boxed quantity is left.

We have other short cuts or refinements in our costing system, but these do not invalidate our considered opinion that the application of standard costs to fairly complex custom built products can be highly successful. In our own case, the benefits obtained have been tremendous and these were garnered at no increase in clerical costs.

PERSONALS

John J. Kroll, a member of the Toronto Chapter, has been elected director and appointed secretary-treasurer of Associated Quarries & Construction Limited. He was formerly comptroller of the company, whose function he will fulfill in addition to his new duties.

Fernand Turgeon, R.I.A., has been appointed controller of Quebec Natural Gas Corporation, Montreal, Quebec. Mr. Turgeon, now a member of the Montreal Chapter, was formerly chairman of the Quebec Chapter.

James G. Hackland, R.I.A., has joined Mannesmann Tube Co. Ltd., Sault Ste. Marie, Ontario as budget analyst. A former member of the Ottawa chapter, Mr. Hackland was employed with Renfrew Aircraft and Engineering Company, Renfrew.

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Organizing For Effective Administration * . .

By J. J. MACDONNELL, F.C.A.,
Partner,
Price, Waterhouse & Co.,
Montreal, Quebec.

Organizing for effective administration falls naturally into four divisions: people, organization, planning and control, and methods. In this article the author reviews each aspect, ferreting out common weaknesses and suggesting remedial measures.

IN CONSIDERING an approach to my subject, it seemed to me that I might try and place before you some of the tests that a management consultant might apply in determining whether or not a business is effectively organized and efficiently administered. Since the art of management consulting is one that cannot readily be learned from text books and must inescapably be somewhat individualized and personalized, it will be readily apparent that what I have to say must be based on personal experience and observation and, therefore, may not be shared by everyone. In other words, these views run every risk of being somewhat controversial.

There are many, many aspects of a business which a management consultant will consider in appraising the effectiveness of its organization and administration but for purposes of this discussion it seemed that at least four factors would be worth mentioning. These are stated briefly as people; organization; planning and control; and methods.

In this hypothetical illustration of a management consultant's reactions and the tests which he applies, it must be assumed that he has been invited by the executive management of a company to make a rather general survey of its organization and administrative practices for the purpose of informing the management as to any deficiencies which he observes and as to his proposals to correct them.

As to People

People of outstanding ability, even though poorly organized, can usually operate a business successfully. People of average ability, if they are well organized, can also operate a business reasonably successfully. But people with average or less than average ability, if they are poorly organized, can very rarely produce successful business results. The point of this is simply that people make the business. Therefore, the management consultant is continually, although often subconsciously, appraising the people with whom he comes in contact during a survey in relation to their individual contributions to the success of the enterprise.

In every business there are innovators and discriminators. As might be expected, there are usually a great many more discriminators than

*An address delivered to the Hamilton Chapter of The Society of Industrial and Cost Accountants of Ontario on November 21, 1957.

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innovators. But this is not necessarily a bad thing. Possibly a management consulting business or a company whose sole activity is research can operate successfully with an all-innovator team, but most businesses would find the mixture somewhat rich for their corporate blood. On the other hand, any business which does not have a proper leavening of innovators at all levels of organizational responsibility is usually heading down hill.

Therefore, if a consultant discovers a dearth of innovators among the managerial personnel he recognizes this instinctively as a danger signal. He then proceeds to look for the cause. The causes are not easy to find and there may be many different reasons for a situation of this type. For instance, an organization headed by a dictator, no matter how able he may be, eventually finds itself with a preponderance of 'yes' men. Men of real ability who are not encouraged to express their views freely without fear or favour will generally seek an environment where they can do so. Sometimes the cause, surprisingly, may be that the top management positions are filled by men who are too young. This may sound almost like a contradiction in terms. Nevertheless, a really top-flight "second man" will usually change his job unless he can see a reasonable prospect of becoming a "first man" before he is too old to care. In other words, if the top executive group comprises men, most of whom may have fifteen or twenty years to go before retirement, it is a somewhat discouraging prospect for a real innovator of ability. Conversely, the lack of a formal retirement plan is frequently the cause of a shortage of innovators in the average company. Most good men are willing to wait for a reasonable period to assume positions of major responsibility but if this period is not capable of definition within reasonable limits or is subject to the whims of the president they will seek opportunities elsewhere.

A tolerance by management of consistently sub-average performance on the part of an employee is a danger sign to a consultant. Usually it is evidence of loose, poorly defined, personnel policies and often may be an indictment of the calibre of management itself. This is not to say that every employee must be a potential president. It does mean that every employee should have capacity and potential to advance at least one more level in the organization.

Another test that is instinctively applied by a consultant as he meets the people comprising the organization is the degree and the manner in which they exercise responsibility. If there is an underlying fear of making a mistake and a relative unwillingness to make decisions without reference to a higher level of authority, this is a bad symptom. Usually, it means that there has been a failure on the part of the higher levels of management to delegate a proper amount of authority and responsibility. By and large this is perhaps the most common fault in most organizations. And it is a serious one because nothing is better for the development of managerial talents than the opportunity to make

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reasonably important mistakes. A man who does not have such an opportunity in his job will after a period of time, develop a fear of ever making a mistake with the result that a potential innovator may become a discriminator.

There are many other points that could be made and have been made by many others in talking about the importance of people to the organization. And these are taken into account by the consultant. For example, such tried and true subjects as development programmes, adequate classification of jobs and compensation therefor, merit rating plans, incentive plans, work measurement plans, and a host of other features of sound personnel administration are all matters that come under review in gaining the "feel" of an organization. Suffice it to say that the consultant who knows his business will almost invariably gain a remarkably clear perception of the state of the business through the contacts which he has with the people who manage and operate it. This is not to say that the wise consultant will ever attempt to substitute his fleeting impressions of the personnel with whom he has come in contact for the seasoned judgment of executive management which has been gained over a long period of time and under many different situations. It is very rare for a consultant to state categorically that such and such a person is incompetent to do his job. Rather these various impressions of people which a consultant gains in the course of his work do enable him to convey a general picture, often re-enforced by factual evidence, of the state of organization and administration practices, whether good or bad. These are the tangible things which can be dealt with.

Some Observations About Organization

There is one thing about organizational planning which is common to most situations, namely, that anyone who supervises at least one other person generally considers himself rather an authority on organizational planning. Perhaps a better way of putting it is simply that very few people are prepared to admit that anything could be seriously wrong with the organization of which they have charge. This very human and very common characteristic helps to make the work of a consultant more interesting, because in no aspect of his work must plain speaking be done with more tact than in the area of organization.

Some very good books and articles have been written about the subject of organization during recent years and it is not my purpose to try and paraphrase the learned authors on this interesting subject but rather to make a few personal observations on some of the common things that are encountered in appraising the effectiveness of an organizational plan.

First and foremost, of course, is the existence or the absence of any formal plan of organization by way of charts, manuals or definitions of duties and responsibilities. It must immediately be admitted that there

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are some very successful enterprises organized along most unorthodox lines. I can think of one very large company where, practically by presidential decree, organization charts are banned. This company is a leader in its field and its officers and personnel generally are men of great ability. Candidly, it has always been something of a mystery to me why this company seems to operate so successfully. Part of the reason may be because it completely dominates its field and therefore is not exposed as much perhaps as ordinary enterprises to the acid test of strong and well-managed competition. This, of course, could have its influence. It is a little bit like the classic test which a consultant usually tries to apply of "how much money is the business not making." In this particular corporation the answer would be difficult to assess.

It seems, however, that by the very fact of its success this corporation to whom I referred can fairly be stated to be the exception rather than the rule. Most companies by now have pretty well conceded that there should exist for purposes of reasonably effective administration some type of visible organization plan.

However, there is a vast difference between a rather informally drawn chart of organization reposing in the back of the president's desk and the type of well-planned organizational manual which is possessed by at least a few companies in this country. It is possible to overdo organizational planning although I have yet to come across a company who has done so. The dearth of organizational planning is a much more common factor contributing to ineffective administration than most management people in this country would believe possible.

On the assumption that at least some form of rudimentary organizational plan has already been committed to paper the consultant's task is to follow relatively orthodox lines in most cases in assessing how well it is adapted to the needs of the business. For example, certain types of business lend themselves well to a decentralized plan of organization while in other cases it is not so effective.

Another rather common test is the observance of span of control. Not many authorities seem to agree on the number of people which one person can supervise. Personally, I have rather thought of it as something in the nature of an hour-glass. At the top of an organization it is quite possible for a chief executive to have a good number of senior executives reporting directly to him or at least having access to him without undue difficulty providing certain conditions are met. One of the most important of these conditions is that he be a good delegator of authority. In fact, perhaps the best executives can be defined as good catalysts or co-ordinators of effort. A man who possesses this quality can usually handle a relatively large number, perhaps as many as ten or twelve, of quite senior people without finding it unduly burdensome.

However, at the middle management level a department or a division head has often a somewhat different type of responsibility and a different calibre of subordinate with the result that his span of control

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may be somewhat less than that of a chief executive. When we arrive at the lowest level of supervision, namely, a section head or a foreman, quite a large number of people engaged in routine work can often be supervised quite effectively. The point about span of control is simply that no hard or fast rule can safely be observed. So much always seems to depend on the conditions and on the individuals.

One of the disadvantages, however, of too short a span of control is that it creates a vertical organization and the chain of command becomes unduly cumbersome. Communications become snarled and there is often a loss of morale because of the large number of levels existing between the lowest level of supervision and the chief executive officer. Therefore, if mistakes must be made, it is usually better to make them in terms of too wide a span of control than too short a span of control.

Another test applied to determine the effectiveness of a plan of organization is the use of staff positions and specialists. A good many executives seem to view staff positions and specialists with mistrust and suspicion. Sometimes these rather harsh words are well justified. Too often, unfortunately, staff men and specialists tend to go in for some quiet empire-building and not infrequently are observed to usurp powers that quite properly do not belong to them. Having said this it can also be stated firmly that the average organization has too few staff men and too few specialists.

Nothing is more helpful in creating more "thinking" time for the executive group than the intelligent use of "assistants to". A good staff assistant can make a tremendous difference in the burdens and pressures carried by the ordinary executive. By the same token, in many companies, there are opportunities for the effective employment of specialist personnel in various staff capacities which are either overlooked or simply not favoured. For example, let us consider the role of economist in the ordinary company. A good many company presidents would consider an economist on the payroll to be a luxury. They incline to the unfounded view, too often held, that an economist may be a long-haired theoretician who has never been exposed to the hard facts of business life. In practice, it is not uncommon for an economist to be one of the most valuable staff advisors to executive management on the whole management team. For instance, his advice on inventory policy may easily be worth thousands or hundreds of thousands of dollars to his management.

Another class of staff specialist, which is all too rare in Canada, is a specialist in the field of sales tax. A good many companies, especially during the past number of years, have become extremely conscious of income taxation. Not so many companies, however, realize that their total bill annually for sales taxes, excise taxes, and customs duties may be far greater than the income tax bill and with more opportunities for abatement through careful study.

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One speaker that I heard not long ago said that there were so many criteria for judging whether a plan of organization fell into the better or the worse category that he became somewhat confused. He went on to say that he had worked out for his own use a sort of quantitative measure which he applied when judging an organization. He said that the basis of his judgment was simply "has the responsibility for *failure* been fixed at the lowest *practical* level and will the person at that level acknowledge his responsibility?" or stated in another way—"does the right to make a mistake *without* reflecting unduly on one's superiors exist at a low enough level?" This speaker who, by the way, was a management consultant, went on to say that by applying this concept he was able to think of a company more as an organized group of individuals, assuming as much responsibility as they can under the guidance and direction of a top management. Previously he had thought of a company as a top management which parcelled out whatever responsibility it rather reluctantly found it could not handle itself. I found this particular concept a refreshingly new one. It requires a certain amount of thought to visualize the application of this theory because it is a little bit topsy-turvy to the ordinary accepted approach. I recommend it, nevertheless, as a useful criterion for anyone to apply in evaluating their own organizational plan.

Before leaving the subject of span of control I should add that the determination of an appropriate span is not necessarily as mysterious or mystical as one might think. Essentially, it is a time study of one's own activities. This in itself can shatter a great many illusions. The study commences with an apportionment or classification of one's main types of endeavour with provision for an unclassified category where each activity is set down specifically. One's secretary can be very helpful in attempting this type of analysis. At the conclusion of a reasonable period some factual information will be gained as to what one does. It is then a question of a critical appraisal to determine those things that were absolutely essential for one to do one's self and those that could just as well have been done by someone else at a lower level. Next it is a question of determining what is a reasonable amount of time to be devoted to working with one's superior officer and comparing that with the actual time. Similarly, one should determine what is a reasonable amount of time to be devoted to the requirements of each person under jurisdiction and again compare that with actual. At this point some interesting facts usually begin to emerge, and it is rare as a result of this analysis for one not to decide on some changes that are possible in one's span of control.

No talk on organization would be complete without some reference to committees. A recent American Management Association survey tended to indicate that the use of committees is increasing rather than diminishing in the management of U.S. companies. This is, of course, a controversial subject but if one may be permitted an observation it is

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simply that the terms of reference and the responsibilities of committees are rarely well defined. A committee whose function and principal purpose is to serve as a means of co-ordinating action and exchanging information is usually a valuable committee providing it does not meet at too frequent intervals. A committee to which is delegated very definite and clearly stated authorities such as the executive committee of a Board of Directors is also a valuable committee as a rule. Unfortunately, however, there are often a great many committees in a company the purposes of which are ill-defined and which serve more to confuse issues than to clarify them. If a company has to lean one way or the other generally more effective organization and administration seems to be provided when there are fewer rather than more committees and their activities are most carefully prescribed and controlled.

A final observation under the general heading of organizational planning is one with respect to the high cost of allowing highly skilled technical personnel to engage unduly in the art of administration. It seems somewhat unfortunate that the measure of an individual's success in most companies seems to depend on the number of people whom he supervises. This naturally places something of a premium in the mind of a technical man on gaining admission to the hierarchy of general management through the back door of administration. It is often sad to see a man who has been a top-flight salesman or a top-flight engineer struggling along with a mountain of paperwork in a job of sales manager or production manager for which he is just not suited. The most enlightened companies are making every effort to make it abundantly clear that a man's importance to the company and the compensation which he can earn is not dependent either on his title or on the evident degree of his responsibilities as an administrator. Some companies are tending to concentrate as much as possible of so-called administration work in the hands of men who are specially trained for this task. More and more one sees recognition being given to a title such as Vice-President — Administration. This is probably a very healthy development.

"Is Anybody Listening?"

A great deal is written and said about planning and control in managing a business enterprise. I think we all know by now that a budgetary control system is a good thing for the average company. I think we also know that few companies can get along without some type of management reporting system. What is important, however, is not the bare facts of having a budgetary control system or a management reporting system but rather what kind and how much.

I wish to make only one observation about the subject of planning and that is that any kind of a budgetary control or planning system that is used without a really complete understanding of it by every level of management and supervision throughout the company is usually an ineffective system. A budgetary control system is in essence a simple

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thing but often it is made to look too complex for the ordinary manager to gain any real understanding of its purpose and use. If it is not understood it becomes too often merely an interesting exercise for the accounting department or even a somewhat expensive and rather useless sort of periodic activity in which everyone engages. It should also be remembered that a budgetary control system is just a good management tool and not necessarily a way of life. In other words, a budgetary control system must never become a rigid strait jacket to prevent imaginative action when it is indicated.

As to management reporting, the answer in most companies is that there are simply too many reports. A short while ago the senior executive of a company told me how he managed to keep up with the volume of essential reports and reading that came to his desk. He said that every morning his secretary placed upon his desk the various reports and reading matter classified in three piles—those that were absolutely essential—those that were essential but not absolutely so—and those that would be interesting to read if he had the time. He told me of his technique. He said that those that were interesting to read if he had the time he put in the wastepaper basket. Those that were essential—but not absolutely so—he put in the top drawer of a conveniently located small filing cabinet. This drawer was emptied by his secretary once a month into the wastepaper basket. The third type—the absolutely essential reports—he put on a table immediately behind him so that at the first opportunity between telephone calls, visitors, meetings, and vital correspondence, he would be able to look through them. In due course the pile of absolutely essential reports and reading became so high that they commenced to fall on the floor and each night the cleaning woman would pick them up along with the contents of the regular wastepaper basket.

This story is not quite as facetious as it probably sounds because the amount of material that the average executive is expected to read is enough to cause complete mental indigestion if he attempted to wade through it all. All this boils down to the fact that there is a great hidden waste in every company in compiling completely useless reports. There is probably no greater service a consultant can render a company than to make a completely objective and critical appraisal of the reports which the executives are expected to read. There is usually a double waste of time in that the reports often cost a good deal of money to produce. Then because a second line executive realizes that the top executive gets a copy of a certain report he himself finds it necessary to devote more time than he should to making sure he understands what he thinks the report is trying to convey in case the chief asks him a question some time about it.

If I knew of a cut and dried answer to the tremendous problem of communications in the average company it would be worth a great deal of money. All I do know is that the reporting system in the ordinary company is exactly like a garden in that regardless of how much

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pruning and cultivation goes on the weeds spring up almost continuously. Therefore, the only practical way that I know of to make serious inroads on this extraordinarily costly business in most companies is to conduct regularly a real housecleaning. Often the man best qualified to conduct this is the chief financial officer providing he is a man who is a good surgeon. Quite a few reports have some relationship to dollar values. Therefore, the financial officer has some part usually in their preparation or in their design. Those reports which he does not have anything to do with can usually bear his scrutiny because they often go to the same people as do the financial reports. I would not wish to give the impression that a meat-axe is the weapon to hack away at the reporting system but rather a good strong pruning knife or, at the very least, a scalpel. Reports in many cases must be tailor-made to the personal requirements of the recipient and this can only be done by a face-to-face and frank discussion with the various managers who are receiving these reports.

Appraising the Methods

Evaluating the efficiency of the administrative methods and practices in force in a company is a big topic in itself. However, from an organizational viewpoint any company which has not made provision, either through a staff unit or specialist, or through the regular reviews of an outside consultant can safely assume that it is wasting money through inefficient methods. There is a continuous development of new and better equipment for cutting office costs. For example, the punched-card equipment today in use is far faster, more flexible, and thus less costly than that in use ten years ago. The same applies to bookkeeping machines. The words "integrated data-processing" have come into vogue and by and large have been made possible through the use of what are called "common language" machines. These are just a few random examples of "office technology".

But, when considering methods, undue emphasis should not be given to equipment because quite frequently a company may possess too much office equipment rather than too little. What is a great deal more important than equipment is the intelligent appraisal of the procedures themselves. And in appraising procedures it is necessary to work backwards. In other words, one must look at what are the results of the procedure and what it is intended to produce before it is possible to gain an insight as to whether or not it is effective. Often very efficient procedures are in force to produce completely useless information.

While it is often possible to produce some rather spectacular economies through the introduction of methods improvements it is well to keep in perspective the fact that the economies produced by methods changes are simply more tangible but by no means more important and sometimes not nearly as large in monetary terms as those which can and are produced through the introduction of more effective organizational planning and more capable people.

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Conclusion

If I were to try to sum up the observations which I have made in this commentary I would probably attempt it along these lines:

- ✓ 1. Make sure that your company has enough of the right kind of people.
- ✓ 2. Try to ensure that you are not discouraging your innovators.
- ✓ 3. Find out if each manager and supervisor has a really clear idea of his own duties and responsibilities and of those people under his direction.
- ✓ 4. Do not hesitate to introduce more formal organizational planning but at the same time make sure that it is not just a one-shot effort.
- ✓ 5. Try to see that your technical people are not overly burdened with administrative detail and paperwork.
- ✓ 6. Find out if you really are using enough staff departments and staff specialists to enable your managerial people to have time to think.
- ✓ 7. Take a long hard critical look at all the reports that are being produced in your company. Have no hesitation in strongly questioning their usefulness and value. If necessary, cut a few out for several months and find out if they are missed.
8. Introduce some means, whether by a staff specialist or by an outside consultant, of making a regular reappraisal of administrative methods.

FOR FURTHER READING

- ORGANIZATION FOR LONG-RANGE PLANNING, by H. E. Wrapp, Harvard Business Review, Jan.-Feb. 1957.
- TWELVE HAZARDS IN ORGANIZING, Factory Management and Maintenance, June 1957.
- EFFECTIVE ADMINISTRATION, ORGANIZATION AND MANAGEMENT, by A. M. Jenkins, Cost and Management, Sept. 1956.

OBITUARY

The Society notes with deep regret the death of Professor Wilfred Berman of the Halifax chapter. Professor Berman was Professor of Commerce at Dalhousie University. Only last year he received a Ford Foundation fellowship to Harvard University's Graduate School of Business Administration, the first Canadian to be so honoured.

An enthusiastic exponent of the accounting profession, the effects of his untiring efforts and excellent teaching ability will be felt within the Society for many years to come.

Labour Standards and Control

By Statistical Methods . . .

By ALLEN WEISS,
Cost Accounting Supervisor,
Lever Brothers Company,
New York, N.Y.

Statistical methods may be employed fruitfully not only in setting labour standards for costing, but also in controlling labour utilization. In the latter application, use of the technique leads immediately to prompt investigation whenever utilization deteriorates into wastefulness, and it results in the long run in improved performance and tighter standards.

WHILE time studies are generally considered to be essential to the establishment of adequate labour standards for costing and control, statistical techniques may be regarded as a simpler and less costly tool which, when properly applied, will yield very satisfactory results. The statistical approach is entirely independent of engineered standards and may therefore be employed even where time studies have not been made.

The only requirement for a statistical analysis of labour costs is the reporting by cost centre of man hours and production daily, weekly, or monthly—depending on the time interval considered most appropriate for control in the particular industry. Wherever the term “weekly period” is used in this paper, applicability to periods other than weekly may be assumed.

When we speak of statistical determination of labour standards, we mean the segregation of labour into two components, fixed and variable, by means of regression (or correlation) techniques. In other words, we recognize that, while labour consumption varies generally with production, a certain amount of inelasticity may be expected even in relatively efficient departments. This inelastic portion we call “fixed”, and it is worthwhile to note that it is not the same as labour cost incurred during a period of shut-down.

That part of labour cost which varies proportionately with production over the range of production encountered in the base period, we refer to as “variable”.

Inasmuch as we are calculating our fixed and variable man hours on the basis of a range of production experience in a recent period, theoretically we are not justified in extrapolating toward either higher or lower production than represented in that range. As a practical matter, however, the range of production, both past and future, is always subject to two limitations: on the low end, an economical minimum for scheduling; and on the high end, capacity of the facilities. Care must be exercised, of course, in selecting a base period, but if the base period is typical and long enough to reflect operations adequately, there is no reason to be overly concerned about the dangers of an occasional extrapolation.

Because the concept of fixed man hours, as described above, presumes a certain range of production, labour expended during any period

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of no production would, if included in calculations, tend to distort the results. For this reason, it is best to edit the raw data by eliminating all periods of shut-down. From these eliminated figures and an estimate of the number and duration of no-production periods in the future (i.e. the budgeted year), "shut-down fixed" man hours for the year should be calculated and added to "inelastic fixed" man hours in arriving at predetermined man hours. Even though included in predetermined cost, however, shut-down fixed man hours must always be excluded from calculations aiming at control of weekly labour cost.

Of the methods of correlation analysis available for segregating fixed and variable labour consumption, we shall mention just two: the visual method and the least-squares calculation.

Regression Line by Inspection

By visual method we mean the construction of a line on a scatter diagram by inspection. First, points are plotted on a grid whose X-axis measures production and whose Y-axis measures man hours. (Exhibit 1 is a scatter diagram with a calculated regression line drawn in). Then a string is manipulated until it is thought to provide as good a representation as possible (with a straight line) of the dots on the chart. A line is drawn in the position occupied by the string.

Interpretation of the chart is accomplished in one of two ways:

1. By reading directly off the line man-hours corresponding to any given production level; or
2. By converting the pictorial line to an equation expressing fixed man hours per week (the Y-ordinate), and variable rate per unit of production (the slope). Calculations thereafter may be made from the equation.

The degree to which a regression line by inspection is truly representative of the data is not calculated, but is judged by scrutiny of the chart. Thus the subjective element so prominent in construction of the line is also present in estimating its usefulness.

Besides the lack of objectivity, there are two additional drawbacks in the use of regression lines by inspection. The first is the tedious nature of the work, which has a tendency to produce errors that are not easily detected. The second is the general absence of chartists in cost departments and the consequent temptation to employ personnel of too high a calibre for the work.

Least-Squares Regression

The objections to a visually-constructed line may be overcome by employing a calculated least-squares regression. This equation represents a line (see Exhibit 1) having two principal characteristics:

1. Deviations of actual from computed values add to zero; and
2. The sum of the squared deviations is smaller than for any other straight line.

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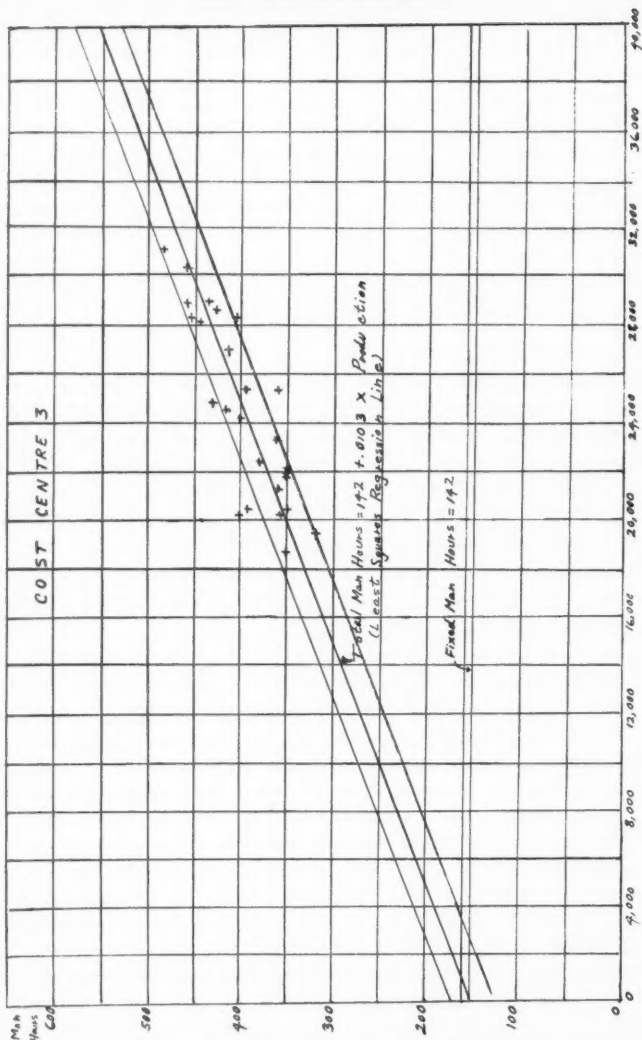


EXHIBIT 1 PRODUCTION

Scatter diagram illustrating calculated least-squares regression line and standard error of estimate. (All calculations are shown in Exhibit 3).

Each week's production and man hours are represented by a small cross.

The regression line intersects the Y-axis at 142 (fixed man hours). The slope of the line is .0103 (variable rate).

Light lines have been plotted at a distance of 1 standard error of estimate above and below the regression line.

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The calculation produces two figures directly: fixed man hours per week, and variable rate in terms of man hours per unit of production. A measure of the scatter of points from the line is also available in the "standard error of estimate". We shall see later that this statistic provides a very useful tool for control purposes.

Because the range of production is limited, we have found that the percentage of the standard error of estimate to the arithmetic mean of man hours is helpful in ascertaining the reliability of values computed from the line. Without some such measure, the lack of a visual presentation would be a very considerable handicap. As it is, there is no way to spot "wild" figures or "breaks" unless a high standard error leads to the plotting of a scatter diagram for the particular cost centre.

The dichotomization of labour into fixed and variable man hours causes all the semi-fixed to be reflected in the fixed and variable figures and also causes semi-fixed factors to increase the value of the standard error of estimate.

In addition to objectivity, the least-squares method has the advantage of flexibility in that calculations may be extended to include additional "dimensions" (i.e. independent variables, or sources of man-hour fluctuation). These dimensions might be factors reducing efficiency, for example: the presence of a second, less experienced crew in an additional packing line, or a second or third shift; or the existence of overtime work. Because the introduction of a third dimension greatly increases the number of calculations, it is not likely to be practicable without a computer. The possibility does exist, however, that variable rates may be desired for factors other than production, and a multiple correlation technique will render such calculations feasible.

The calculation of a least-squares linear regression on an electronic computer is a relatively simple job to program. Exhibit 2 is a block diagram outlining a computer program for a least-squares line. The use of a floating decimal technique or repeated tests for overflow would be required in practice, but these considerations have been omitted from Exhibit 2.

There are departments whose labour cost is inflexible within the usual range of production, and because the entire labour cost is fixed, the variable rate should be zero. But because of what may be termed sampling errors—such circumstances as a crew keeping an operation going at a fairly high level of activity despite the absence of one man—the calculated rate may actually come up negative. Inasmuch as a negative rate will not be used (there are exceptions in connection with multiple correlations), it is well to program the computer to test for negative results, and to make certain additional calculations whenever they occur. If the variable rate is negative, the computer should report out separately a zero rate and a corresponding fixed figure, based on the assumption that labour is all fixed (average man hours per period). If fixed man hours comes up negative, the computer should report out separately zero fixed man hours and a corresponding variable rate,

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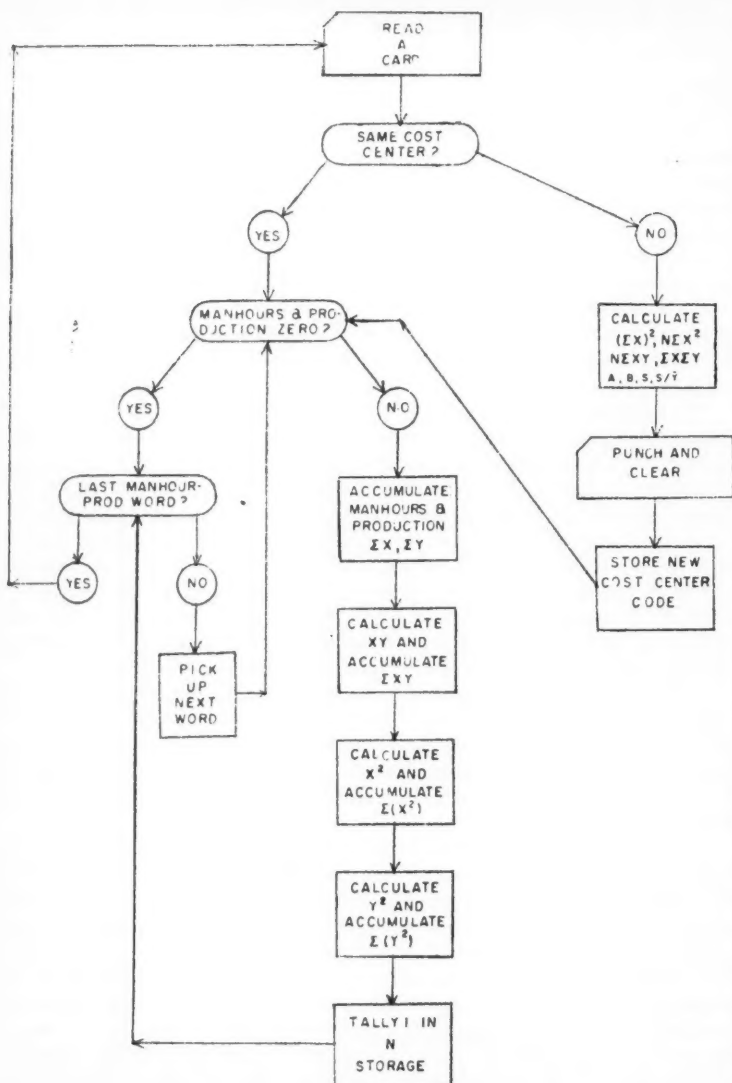


EXHIBIT 2

Block diagram for an IBM 650 computer program to calculate the parameters for a least-squares linear regression. Considerations of floating decimal point or tests for overflow have been omitted.

LABOUR STANDARDS AND CONTROL BY STATISTICAL METHODS

based on the assumption that labour is all variable (total man hours divided by total production).

During the past three years, our company has progressed from visual charts to electronic computation of a least-squares linear regression. In the course of this shift to the computer, we went through an intermediate stage—comptometer calculation of least-square lines. A sample calculation is presented in Exhibit 3 to illustrate the working papers. The data and the calculated regression line are the same as shown in Exhibit 1.

COST CENTRE NUMBER 3 LEAST-SQUARES REGRESSION LINE

Period	Production X	Man Hours Y	XY	X ² M	Y ²
1	31,053	484	15,029,652	964,289	234,256
2	30,360	459	13,935,240	921,730	210,681
3	28,975	458	13,270,550	839,551	209,764
4	28,402	402	11,417,604	806,674	161,604
5	28,410	454	12,898,140	807,128	206,116
6	28,974	434	12,574,716	839,493	188,356
7	24,907	434	10,809,638	620,359	188,356
8	21,350	360	7,686,000	455,823	129,600
9	26,931	411	11,068,641	725,279	168,921
10	25,321	392	9,925,832	641,153	153,664
11	28,587	426	12,178,062	817,217	181,476
12	24,342	399	9,712,458	592,533	159,201
13	28,119	444	12,484,836	790,678	197,136
14	20,327	355	7,216,085	413,187	126,025
15	24,714	416	10,281,024	610,782	173,056
16	23,368	358	8,365,744	546,063	128,164
17	25,276	359	9,074,084	638,876	128,881
18	22,549	380	8,568,620	508,457	144,400
19	20,596	350	7,208,600	424,195	122,500
20	21,766	350	7,618,100	473,759	122,500
21	22,099	350	7,734,650	488,366	122,500
22	19,405	314	6,093,170	376,554	98,596
23	21,947	350	7,681,450	481,671	122,500
24	18,855	350	6,599,250	355,511	122,500
25	20,538	390	8,009,820	421,809	152,100
26	20,216	397	8,025,752	408,687	157,609
N=26	637,387	10,276	255,467,718	15,969,824M	4,110,462
	ΣX	ΣY	$\Sigma (XY)$	$\Sigma (X^2)$	$\Sigma (Y^2)$

EXHIBIT 3 (A)

Raw data and primary calculations for one cost centre.

MAN HOURS VS. PRODUCTION

Line	Formula	Units	1	2	3	4	5
1	N					26	
2	ΣX					637,387	
3	ΣY					10,276	
4	$\Sigma (XY)$	M				255,468	
5	$\Sigma (X^2)$	M				15,969,824	
6=	1×4	M				6,642,168	
7=	1×5	M				415,215,424	
8=	2×2	M				406,262,188	
	$(\Sigma X)^2$						

COST AND MANAGEMENT

9=	2×3	$\sum X \sum Y$	M	6,549,789
10=	2×4	$\sum X \sum (XY)$	MM	162,831,982
11=	5×3	$\sum (X^2) \sum Y$	MM	164,105,911
12=	11-10	$\sum (X^2) \sum Y - \sum X \sum (XY)$	MM	1,273,929
13=	7-8	$N \sum (X^2) - (\sum X)^2$	M	8,953,236
14=	6-9	$N \sum (XY) - \sum X \sum Y$	M	92,739
15=	12+13	a		142
16=	14+13	b		.0103
17=	2÷1	X		24,515
18=	3÷1	Y		395
19=	16×17	b X		252
20=	18-15	Y-a		253
21		$\sum (Y^2)$		4,110,462
22=	15×3	a $\sum Y$		1,459,192
23=	16×4	b $\sum (XY)$		2,631,320
24=	21-22-23	$\sum (Y^2) - a \sum Y - b \sum (XY)$		19,950
25=	24÷1	S ²		767
26=	√25	S		28
27=	26÷18	S/Y	EXHIBIT 3 (B)	7%

Calculations of fixed man hours (a), variable rate (b) and standard error of estimate (S) for one cost centre are shown.

Calculations are based on the following formulae:

$$a = \frac{\sum X^2 \sum Y - \sum X \sum XY}{N \sum X^2 - (\sum X)^2}$$

$$b = \frac{N \sum XY - \sum X \sum Y}{N \sum X^2 - (\sum X)^2}$$

$$S = \frac{1}{\sqrt{N}} (\sum Y^2 - a \sum Y - b \sum XY)$$

In the illustration, the general equation $Y=a+bX$ becomes $Y=142+.0103X$ and $S=28$.

Because the line passes through the point (X,Y), at that point the equation becomes $Y=a+bX$. Hence $Y-a=bX$, which is the basis for the check on accuracy employed. If line 19 equals line 20, the calculations of a and b may be considered correct.

Control of Labour Utilization

Having adopted statistical determination of labour standards, the next step is to apply these standards to the control of labour cost.

There are three prerequisites for control:

1. Data on current operations.
2. A standard for comparison.
3. A limit of variance to be tolerated.

1. The only current data required for control of labour utilization are weekly production units and man hours for each cost centre. The handling of data for a week including a holiday is simple enough, but outside the scope of this paper.

2. Standard labour consumption is computed from the formula: Standard man hours=Fixed man hours+(Variable rate×Production units).

LABOUR STANDARDS AND CONTROL BY STATISTICAL METHODS

3. The variance (V) of actual from standard is calculated and expressed in terms of the standard error of estimate (S). The ratio $\frac{V}{S}$ is the statistic for which control limits are established.

COST CENTRE 3

Period	Production X	Actual Man Hours Y	Standard Variable .0103X	Man Hours Total $Y=142+\text{S}.0103X$	Variance $V=Y-Y$ A S	Variance+ Standard Error of Estimate V/28
		A				
1	22,465	386	231	373	13	.5
2	24,289	414	250	392	22	.8
3	26,240	502	270	412	90	3.2
4	34,454	498	355	497	1	—
5	33,930	490	349	491	(1)	—
6	30,147	484	311	453	31	1.1
7	32,848	428	338	480	(52)	(1.9)
8	22,069	393	227	369	24	.9
9	30,265	449	312	454	(5)	(.2)
10	26,871	409	277	419	(10)	(.4)

EXHIBIT 4

Calculation of standard man hours from a least-squares regression formula ($Y=142+.0103X$). Calculation of variance and of the ratio of variance to standard S

error of estimate. Control limits are set for values in the last column on the right.

Exhibit 4 illustrates the calculations required for control of a single cost centre over ten periods. The line arrived at in Exhibit 3 is the basis for all calculations in Exhibit 4.

The usefulness of the standard error of estimate for control purposes stems from the fact that it is analogous to the standard deviation of a distribution of errors of measurement, and normal-curve theory and probability tables are therefore applicable. Thus, a table of Areas Under the Normal Curve (Exhibit 5) may be consulted to determine for what percentage of weeks V can be expected to be greater than any S

given figure (assuming that the system of causes of variation carries over from the base period unchanged).

It is readily apparent that a control limit can be set so that excessive variances will be investigated with any preassigned frequency. Thus, if it is considered desirable to investigate about 8% of the time: subtracting 8% from 50% leaves 42%. In the table of Areas Under the Normal Curve 41.92% occurs opposite an argument of 1.4 (Exhibit 5). Therefore, an upper limit of 1.4 for V/S will result in 8% investigation.

Nor is it necessary to set a single upper control limit. It may be desirable, for example, to set a limit of 1.5 for a single week, 1.2 for two successive weeks, and .8 for three successive weeks. With these limits in effect, a value of 1.2 for V/S will lead to investigation if and only if it occurs in two successive periods, and a value as low as .8 will lead to investigation if it occurs three times in a row. This set of limits, incidentally, may be expected to result in 9% investigation.

COST AND MANAGEMENT

Admittedly, the underlying assumption—that the system of causes of variation will be similar to the one prevailing during the base period—is a broad one, but as a practical matter, it requires no proof or justification in this application, if only because the application of the

AREAS UNDER THE NORMAL CURVE

V/S	Percentage of Total Area	V/S	Percentage of Total Area
0.0	.00%	1.5	43.32%
0.1	3.98	1.6	44.52
0.2	7.93	1.7	45.54
0.3	11.79	1.8	46.41
0.4	15.54	1.9	47.13
0.5	19.15	2.0	47.73
0.6	22.57	2.1	48.21
0.7	25.80	2.2	48.61
0.8	28.81	2.3	48.93
0.9	31.59	2.4	49.18
1.0	34.13	2.5	49.38
1.1	36.43	2.6	49.53
1.2	38.49	2.7	49.65
1.3	40.32	2.8	49.74
1.4	41.92	2.9	49.81
		3.0	49.865

EXHIBIT 5

Areas under the normal curve from the mean to values of V/S from 0.0 to +3.0, expressed as a percentage of the total area.

principle itself is loose. We are not attempting to establish a rigorous proof of anything; we are merely estimating the percentage of weeks that will be looked at more closely.

It would be well at this point to explicate the meaning of 8% investigation, as the term is used above. When the upper control limit is set for 8% investigation, we expect to go back to a department 8% of the time to seek out the causes behind a poor showing. An investigation may be formal or informal in nature, and it may vary from mere questioning of a foreman concerning the situation that caused low productivity to a detailed study of the department and its methods. The end results may vary from radical changes in procedures to a tentative conclusion of the impracticality of undertaking remedial measures. In any case, if the system of causes does not change we shall be investigating whenever that system is operating at its worst. And if the system of causes does undergo a change for the worse, that is if some new factor causes performance to deteriorate, we shall be investigating more frequently until the new difficulty is eliminated. Indeed, the standard error of estimate can frequently help to detect promptly the presence of a deleterious new factor. For V/S should not exceed a value of 2.0 (in the direction of low productivity) with greater frequency than 2.3% (from Exhibit 5: 50% minus 47.73%) and it should exceed 3.0 no more than .135% of the time, unless a change in the system of causes has occurred. A second control limit may be set at a figure higher than the first (e.g. at 2.0, or 3.0) and a value of V/S in excess of this second

LABOUR STANDARDS AND CONTROL BY STATISTICAL METHODS

limit may be made the signal for a more thorough study of causes on the assumption that it indicates, in all likelihood, a change in the pattern of factors influencing productivity.

We are now ready to meet the objection that statistically determined standards are not applicable to control procedures because they are based on past inefficiencies and tend to sanction them. What we hope to accomplish with statistical controls is to eliminate inefficiency and reduce cost without unwarranted harassment of production personnel by:

1. Investigating only those periods which are farthest out of line.
2. Determining in a sound, scientific manner which periods are really the worst in terms of performance.
3. Arriving at our determinations promptly. Each department need report only two figures, both of which are readily available and normally reported anyway. The calculations of standard, variance, and V/S are short and simple.
4. Revising standards annually to pick up the gains that are made. Improvement in one year is reflected in tightened standards for the succeeding year.

No mention has been made of inter-plant comparisons. In making such studies, and in appraising results from year to year, it is well to understand the meaning of differences in each of the two types of costs:

1. Lower fixed man hours means greater elasticity, a tendency to reduce staff more promptly when production schedules are cut. The mere existence of (calculated) fixed man hours where logically there should be none is sufficient reason to raise the question of inelasticity at once.
2. Lower variable man-hour rate indicates a more productive use of manpower, or less waste of effort.

Glossary of Terms

Least-squares linear regression: A regression formula is an equation (or, pictorially, a curve) expressing mathematically the relationships among variables. If there are but two variables, the regression is simple; for more than two it is multiple. A simple or multiple regression may be linear (i.e. straight line or first degree equation) or curvilinear (i.e. equation of higher degree). If the formula is calculated in such a manner that the algebraic sum of deviations from it is zero and the sum of squared deviations is minimal, the result is a least-squares regression.

Standard deviation: The root-mean-square of deviations from the arithmetic mean of a distribution.

Standard error of estimate: The root-mean-square of deviations from a least-squares regression line.

Control limit: A value of V/S below which variances will be tolerated, but at or above which variances will be investigated in an effort to determine causes and remedies.

Automatic Recording of Unemployment Insurance Contributions . . .

By M. P. MCBAIN,
*Secretary-Treasurer,
Kellogg Company of Canada, Limited,
London, Ontario.*

The system outlined below satisfactorily answers stipulations of the Unemployment Insurance Commission for bulk plan payments and simplifies the work of the Department's auditors, yet uses only five tabulating cards and one small form per year for each employee.

BASIC requirements of the unemployment insurance regulations for bulk plan payments which appear not to have been fully met with previous simple tabulating machine systems are:

1. Prompt release of book to employee at termination;
2. Printed record available for examination by employee at any time;
3. Ability of auditors for the Commission to readily reconcile the thousands of entries with the monthly remittances and the payroll deductions;
4. Ability to show deductions by week or pay period.

Our regular payroll procedure involves preparation of a punch card for each cheque issued. This is the basis for all pay records and summaries for the employee, such as pension records, union dues, income tax, etc., including deductions for unemployment insurance. The new system merely transfers a portion of the information from this card to the unemployment insurance punch card.

A permanent master punch card is prepared for each employee showing his name, personnel number, clock number, and unemployment insurance number. This is for use when an employee terminates or for preparing the annual reports to the Unemployment Insurance Commission.

Quarterly Cards

A quarterly card is prepared for each employee on which is punched his personnel number and date of first contribution.

This card is divided into 14 columns of two digits each plus columns providing for sub-totals and total. The first week of the quarter the reproducing or summary punch is used to reproduce the unemployment insurance deductions from the payroll card into column 1 of the quarterly card. The second week the punch is wired to insert the information into column 2, etc. Hence, without manual operations, each week's contribution is recorded into a card record for the employee so that the card is a complete record of his contributions for the quarter to date.

Owing to limitations in our machine capacity we use our multiplier to cross-foot and punch sub-totals to date at regular intervals, leading to a total for the quarter.

AUTOMATIC RECORDING OF UNEMPLOYMENT INSURANCE CONTRIBUTIONS

Proof is obtained in total each week by running all current cards through the tabulator and adding all columns, totals of which are then combined to balance with the total of the deductions on all payrolls for this quarter to date, using a schedule as illustrated in Exhibit A1. A schedule (Exhibit A2) is maintained by quarters showing the accumulated total of deductions recorded on all cards which have been withdrawn during the quarter for terminating employees and this total must be deducted on Exhibit A in order to obtain a balance.

For our semi-monthly payroll the quarterly cards are divided into six columns. Otherwise the procedure is the same as for weekly-paid employees but a deduction code (specified by the Commission) is included on the payroll card and reproduced in an adjoining column on the unemployment insurance quarterly card.

Annual Reporting

A new continuous form replacing form UIC 443 was designed for reporting annually to the Unemployment Insurance Commission. This provides spaces for 53 weeks in four lines, one line for each quarter. These spaces are numbered in accordance with a schedule (UIC-399K) provided by the Commission. In the case of our semi-monthly payroll, the form shows the actual date of each period. Samples of these forms are shown as Exhibits B and C. As at April 1 each year, or January 1 if a calendar basis is used, the heading cards and the cards for the four quarters are sorted together and listed by the tabulator on these forms, with a total for the year shown at the bottom of each employee's form. The name, unemployment insurance number, date of first contribution and date of last contribution are also shown. This is all a completely automatic operation. At the present time the commission files these reports on end, so that provision is made to type the name and unemployment insurance number at one end for easier reference. If side filing is adopted at some future date, this will become unnecessary since the heading printed by the tabulator will suffice.

The annual forms UIC 443 are forwarded to the Commission for their files and it is not necessary to issue new books each year.

When an employee terminates, his cards for the year to date, together with his master card, are manually withdrawn and run through the tabulator to print on a special form UIC 443 which is identified by a large red number UIC 443H as shown in Exhibits D and E. This could be done at any time on request, but it is usually possible to defer action till the tabulator is being changed from one operation to another, or at the end of the day. This form marked UIC 443H is acceptable to the Commission as an alternative to the Commission's handwritten form 443H and can be run off more accurately and with less effort than determining the contributions, recapping them and entering them by hand on the commission's form 443H.

Our payroll cards are usually summarized quarterly to reduce year-end work and it is possible to run a comparison of the quarterly

D

UN. INSURANCE NO. 1
WEEK C
WEEK C
WEEK C

WEEK
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EMPLOYERS

10

- #### 4. THE BUDGET

1

CER

EMPLOYEE'S NAME

FOR

AUTOMATIC RECORDING OF UNEMPLOYMENT INSURANCE CONTRIBUTIONS

EXHIBIT A2

UNEMPLOYMENT INSURANCE — INACTIVE FILE

Date	Total Withdrawn For This Quarter		Date	Total Withdrawn For This Quarter		Date	Total Withdrawn For This Quarter	
	Today	To-Date		Today	To-Date		Today	To-Date

EXHIBIT B

1	2	3	4	SMITH JOHN PETER::	K	3	9	5	7	6	2
PERS. NO.				EMPLOYEE'S NAME				UNEMPLOYMENT INSURANCE NO.			

WEEK NO. U.I.C. 399K	14	15	16	17	18	19	20	21	22	23	24	25	26	TOTAL FOR QUARTER
CONTRIBUTION				48	60	60	60	60	60	60	60	60	60	588
WEEK NO. U.I.C. 399K	27	28	29	30	31	32	33	34	35	36	37	38	39	
CONTRIBUTION	60	60	60	60	60	60	60	60	60	60	60	60	60	780
WEEK NO. U.I.C. 399K	40	41	42	43	44	45	46	47	48	49	50	51	52	53
CONTRIBUTION	60	60	60	60	60	60	60	60	60	60	60	60	60	840
WEEK NO. U.I.C. 399K	1	2	3	4	5	6	7	8	9	10	11	12	13	
CONTRIBUTION	60	60	60	60	60	56	48	60	60	60	56	60	60	760
														2968

4	2	3	5	6	0	3	2	6	5	7
MONTH	DAY	YEAR	MONTH	DAY	YEAR					
DATE OF FIRST CONTRIBUTION						DATE OF LAST CONTRIBUTION				

WEEKLY PAYROLL ACCOUNT
(CALENDAR WEEK-NUMBERED PER FORM U.I.C. 399K.)

CERTIFIED THAT TOTAL CONTRIBUTIONS, THE EMPLOYEE'S SHARE OF WHICH ARE AS INDICATED ABOVE, HAVE BEEN FORWARDED TO THE UNEMPLOYMENT INSURANCE COMMISSION FOR THE PERSON WHOSE NAME APPEARS AT THE TOP OF THIS STATEMENT.

EMPLOYER'S NAME

KELLOGG COMPANY OF CANADA, LIMITED
LONDON, ONTARIO

EMPLOYER'S REGISTRATION NO. 141366

U.I.C.

BULK PAYMENT 4796
PERMIT NO.
FORM U.I.C. 443 (WEEKLY)

EXHIBIT C

1	2	3	4		K						
PERS. NO.				EMPLOYEE'S NAME				UNEMPLOYMENT INSURANCE NO.			

APR. 1-15	APR. 16-30	MAY 1-15	MAY 16-31	JUNE 1-15	JUNE 16-30	TOTAL FOR QUARTER
JULY 1-15	JULY 16-31	AUG. 1-15	AUG. 16-31	SEPT. 1-15	SEPT. 16-30	
OCT. 1-15	OCT. 16-31	NOV. 1-15	NOV. 16-30	DEC. 1-15	DEC. 16-31	
JAN. 1-15	JAN. 16-31	FEB. 1-15	FEB. 16-28	MAR. 1-15	MAR. 16-31	

MONTH	DAY	YEAR	MONTH	DAY	YEAR						
DATE OF FIRST CONTRIBUTION						DATE OF LAST CONTRIBUTION					

SEMI-MONTHLY PAYROLL ACCOUNT

CERTIFIED THAT TOTAL CONTRIBUTIONS, THE EMPLOYEE'S SHARE OF WHICH ARE AS INDICATED ABOVE, HAVE BEEN FORWARDED TO THE UNEMPLOYMENT INSURANCE COMMISSION FOR THE PERSON WHOSE NAME APPEARS AT THE TOP OF THIS STATEMENT.

EMPLOYER'S NAME

KELLOGG COMPANY OF CANADA, LIMITED
LONDON, ONTARIO

EMPLOYER'S REGISTRATION NO. 141366

U.I.C.

BULK PAYMENT 4796
PERMIT NO.
FORM U.I.C. 443 (SEMI-MONTHLY)

COST AND MANAGEMENT

EXHIBIT D

PERS. NO.		EMPLOYEE'S NAME																				UNEMPLOYMENT INSURANCE NO.									
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UNEMPLOYMENT INSURANCE NO.	WEEK No. 1 U.I.C. 399K	14	15	16	17	18	19	20	21	22	23	24	25	26	TOTAL FOR QUARTER
	CONTRIBUTION														
	WEEK No. 12 U.I.C. 399K	27	28	29	30	31	32	33	34	35	36	37	38	39	
	CONTRIBUTION														
	WEEK No. 13 U.I.C. 399K	40	41	42	43	44	45	46	47	48	49	50	51	52	
	CONTRIBUTION														
	WEEK No. 14 U.I.C. 399K	1	2	3	4	5	6	7	8	9	10	11	12	13	
	CONTRIBUTION														

MONTH	DAY	YEAR	MONTH	DAY	YEAR
DATE OF FIRST CONTRIBUTION		DATE OF LAST CONTRIBUTION			

WEEKLY PAYROLL ACCOUNT
(CALENDAR WEEK-NUMBERED PER FORM U.I.C.399K)

CERTIFIED THAT TOTAL CONTRIBUTIONS, THE EMPLOYEE'S SHARE OF WHICH ARE AS INDICATED ABOVE, HAVE BEEN FORWARDED TO THE UNEMPLOYMENT INSURANCE COMMISSION FOR THE PERSON WHOSE NAME APPEARS AT THE TOP OF THIS STATEMENT.

EMPLOYER'S NAME
NO. 141356

BULK PAYMENT PERMIT NO. **4796**

FORM U.I.C. 443 (WEEKLY)

U. I. C.
443 H

EMPLOYER'S NAME
KELLOGG COMPANY OF CANADA, LIMITED
LONDON, ONTARIO

EXHIBIT E

PERS. NO.		EMPLOYEE'S NAME																				UNEMPLOYMENT INSURANCE NO.									
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UNEMPLOYMENT INSURANCE NO.	APR. 1-15	APR. 16-30	MAY 1-15	MAY 16-31	JUNE 1-15	JUNE 16-30	TOTAL FOR QUARTER
	JULY 1-15	JULY 16-31	AUG. 1-15	AUG. 16-31	SEPT. 1-15	SEPT. 16-30	
	OCT. 1-15	OCT. 16-31	NOV. 1-15	NOV. 16-30	DEC. 1-15	DEC. 16-31	
	JAN. 1-15	JAN. 16-31	FEB. 1-15	FEB. 16-28	MAR. 1-15	MAR. 16-31	

MONTH	DAY	YEAR	MONTH	DAY	YEAR
DATE OF FIRST CONTRIBUTION		DATE OF LAST CONTRIBUTION			

SEMI-MONTHLY PAYROLL ACCOUNT

CERTIFIED THAT TOTAL CONTRIBUTIONS, THE EMPLOYEE'S SHARE OF WHICH ARE AS INDICATED ABOVE, HAVE BEEN FORWARDED TO THE UNEMPLOYMENT INSURANCE COMMISSION FOR THE PERSON WHOSE NAME APPEARS AT THE TOP OF THIS STATEMENT.

EMPLOYER'S REGISTRATION NO. 141356

BULK PAYMENT PERMIT NO. **4796**

FORM U.I.C. 443 (SEMI-MONTHLY)

U. I. C.
443 H

EMPLOYER'S NAME
KELLOGG COMPANY OF CANADA, LIMITED
LONDON, ONTARIO

